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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/920,834	08/03/2001	Naoyuki Kofuji	NIT-288	7522

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MATTINGLY, STANGER & MALUR
1800 DIAGONAL ROAD
SUITE 370
ALEXANDRIA, VA 22314-2840

EXAMINER

CHEN, KIN CHAN

ART UNIT	PAPER NUMBER
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1765

DATE MAILED: 07/30/2003

10

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

09/920,834

Applicant(s)

KOFUJI ET AL.

Examiner

Kin-Chan Chen

Art Unit

1765

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --
Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☐ Responsive to communication(s) filed on 30 June 2003.
- 2a) ☒ This action is FINAL. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-6 and 8 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-6 and 8 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on _____ is: a) ☐ approved b) ☐ disapproved by the Examiner.
If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All b) ☐ Some * c) ☐ None of:
1. ☒ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- 1) ☐ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____
- 4) ☐ Interview Summary (PTO-413) Paper No(s). _____
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other:

DETAILED ACTION

Priority

1. Receipt is acknowledged of papers submitted under 35 U.S.C. 119(a)-(d), which papers have been placed of record in the file.

Information Disclosure Statement

2. Applicant requests that the examiner initials reference AR of PTO-1449 (August 3, 2001) is not considered because the reference AR does not have the publication date of the article.

Drawings

3. Figure 2 should be designated by a legend such as --Prior Art-- because only that which is old is illustrated. See MPEP § 608.02(g). A proposed drawing correction or corrected drawings are required in reply to the Office action to avoid abandonment of the application. The objection to the drawings will not be held in abeyance. Figure 2 is clearly described under "Description of the related Prior Arts", see page 1 of the specification, and a method "prior to the present invention", see page 13 of the specification. **Therefore, it should be designated by a legend such as --Prior Art--.**

Claim Rejections - 35 USC § 103

4. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

5. Claims 1 and 2 are rejected under 35 U.S.C. 103(a) as being unpatentable over admitted prior art in view of Young et al. (US 6,457,477; hereinafter "Young") and Zhao (US 6,071,809).

Admitted prior art (specification, page 2 line 7 through page 3, line 18 and page 4, lines 1-6) is only relied on to show some conventional process steps for forming trench structure and copper interconnect comprising forming a first insulating material, forming thereon a second insulating material with a dielectric constant less than 2.5, patterning the second insulating material layer by a plasma etching method (third step), depositing a metal film on the second insulating material layer by a sputtering method (fourth step), forming a copper layer on the metal film and removing an unnecessary portion of the copper layer by chemical mechanical polishing.

Unlike the claimed invention, the conventional process steps (admitted prior art) do not disclose that all the processes from the third step to the fourth step are performed under dry process condition. The admitted prior art uses wet cleaning between the third and the fourth step. In a method of cleaning a porous low-k etched

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opening (such as trench opening, col. 1, lines 10-12), Young teaches using a full dry cleaning process (e.g., using H_2 and He) instead of a wet clean process so as to no solvent molecules to be trapped within the pores of porous low-k layer (col. 5, lines 46-51; col.6, lines 15-18). Hence, it would have been obvious to one with ordinary skill in the art to modify conventional process steps (admitted prior art) by using a full dry cleaning process as taught by Young in order to have no solvent molecules to be trapped within the pores of porous low-k layer. The claimed invention differs from the prior art by specifying cleaning the sample with pure water after chemical mechanical polishing (sixth step), however, it is conventional to clean the sample with pure water after chemical mechanical polishing (CMP). Zhao is relied on to show said conventional step (see col. 8, lines 41-42). Because it is a conventional method in the art of semiconductor device fabrication and because it is disclosed by Zhao, hence, it would have been obvious to one with ordinary skill in the art to cleaning the sample with pure water after CMP in the combined prior art in order to provide their art recognized advantages and produce an expected result.

As to dependent claim 2, because the combined prior art using dry etching/cleaning process, therefore, it would have been obvious to one with ordinary skill in the art that the sample stay in the chamber without exposing to the atmosphere during the third and fourth steps because it is more efficient.

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6. Claims 3-6 and 8 are rejected under 35 U.S.C. 103(a) as being unpatentable over admitted prior art, Young and Zhao as applied to claim 1 above, and further in view of Loewenstein (US 5,741,396).

The discussion of modified admitted prior art, Young and Zhao from above is repeated here.

As to dependent claim 3, unlike the claimed invention, admitted prior art, Young and Zhao do not teach using NF_3 and Ar to etch the insulating layer. In a method of nitride layer etching, Loewenstein (col. 2, lines 51-55; col.7, lines 51-52) teaches that NF_3 and Ar may be used to etch the insulating layer (e.g., silicon nitride) in order to have high etching selectivity. Hence, it would have been obvious to one with ordinary skill in the art to modify admitted prior art, Young and Zhao by using NF_3 and Ar to etch the insulating layer as taught by Loewenstein in order to have high etching selectivity.

As to dependent claim 6, the combined prior art teaches using hydrogen plasma process after etching the insulating layer (e.g., silicon nitride), col. 1, lines 53-62 of Young.

The instant claims 4, 5, and 8 differ from the combined prior art by specifying various process parameters (such as electric power in claim 4; plasma pressure in claim 5, negative DC voltage in claim 8). However, they are commonly determined by routine experiment in the art of plasma etching /cleaning, in the absence of showing new, unexpected (unobvious) results, which is different in kind and not merely in degree from the results of the prior art, it would have been obvious to one of ordinary skilled in the art to determine the suitable process parameters through routine experimentation in the

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combined prior art in order to obtain the best etched product achievable. It is noted that applicant did not traverse the aforementioned conventionality (e.g., well-known features, obviousness), which have been stated in the office action in Paper No. 6.

As to dependent claim 8, because the combined prior art teaches the claimed process, hence, it would have been obvious to one with ordinary skill in the art to use the conventional plasma etching apparatus as claimed for the process.

The apparatus limitations do not have weight in process claim, unless they affect the process in a manipulative sense.

In re Tarzy-Hornock, 158 USPQ 141. Or *Ex parte Pfeiffer* 135 USPQ 31

Response to Arguments

7. Applicant's arguments filed June 30, 2003 have been fully considered but they are not persuasive.

Applicant has argued that the combined Young and Zhao does not include a fully dry-type processing including trench process. However, it is noted that the features upon which applicant relies (a fully dry-type processing including trench process) are not recited in the rejected claim(s). Although the claims are interpreted in light of the specification, limitations from the specification are not read into the claims. See *In re Van Geuns*, 988 F.2d 1181, 26 USPQ2d 1057 (Fed. Cir. 1993). The instant claims only specify the processes from the third to the fourth step are performed under dry process conditions. Furthermore, as has been stated in the office action, Admitted prior art (specification, page 2 line 7 through page 3, line 18 and page 4, lines 1-6) is relied on to

show conventional process steps for forming trench structure and copper interconnect. Also, Young teaches using a full dry cleaning process (e.g., using H₂ and He) instead of a wet clean process to clean **trench opening for copper interconnect / damascene** (col. 1, lines 6-12) so as to no solvent molecules to be trapped within the pores of porous low-k layer. Therefore, the combined prior art teaches the claimed invention, and accordingly contains the claimed properties and effects such as solving the problem regarding degradation of a copper surface and eliminating the problem of chemicals being trapped in the porous low-k film.

One cannot show nonobviousness by attacking references individually where the rejections are based on combinations of references. In re Merk & Co., Inc., 800F.2d 1091, 231 USPQ 375 (Fed. Cir. 1986). (our ref. Only ..MPEP 2145 IV.)

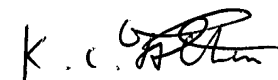
Conclusion

8. THIS ACTION IS MADE FINAL. Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire **THREE MONTHS** from the mailing date of this action. In the event a first reply is filed within **TWO MONTHS** of the mailing date of this final action and the advisory action is not mailed until after the end of the **THREE-MONTH** shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than **SIX MONTHS** from the mailing date of this final action.

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9. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Kin-Chan Chen whose telephone number is (703) 305-0222. If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Benjamin Utech can be reached on (703) 308-3836. The fax phone numbers for the organization where this application or proceeding is assigned are (703) 872-9310 for regular communications and (703) 872-9311 for After Final communications. Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-2934.


Kin-Chan Chen
Primary Examiner
Art Unit 1765

K-C C
July 21, 2003